

SUBSTITUTE SPECIFICATION

TITLE OF THE INVENTION

[0001]

HYDROGEN GENERATING APPARATUS

BACKGROUND OF THE INVENTION

[0002] The present invention relates to a hydrogen generating apparatus which uses a fuel hydrocarbon or the like and water as raw materials and gives a hydrogen gas by steam reforming of the fuel.

[0003] For producing hydrogen, there are methods of steam reforming of fuels. In these methods, fuels such as natural gas, hydrocarbons like LPG, alcohols like methanol, naphtha and the like and water are used as raw materials and the fuels are subjected to a steam reforming reaction in a reforming part or reactor equipped with a reforming catalyst to generate hydrogen. There is also provided a shifting part conventionally for shifting water and carbon monoxide since carbon monoxide is produced as a by-product in the above-described steam reforming reaction.

[0004] Further, when a steam reforming method is used for supplying hydrogen to fuel cells, particularly to a solid polymer fuel cell, a purification part utilizing a carbon monoxide oxidizing method, methanization method or the like is provided for further removal of carbon monoxide in a shifted gas passed through a shifting part. The above-described reforming part, shifting part and purification part are equipped with catalysts corresponding to respective reactions and the reaction temperatures differ depending on the catalysts, therefore, there is a need to heat respective catalysts to respective reaction temperatures for stable generation of hydrogen.

[0005] In such hydrogen generating apparatuses, the temperature in the reforming part is most high and the temperature lowers gradually in the order of the reforming part, the shifting part into which a reformed gas flows in and the purification part into which a shifted gas flow in since a heating part is provided only in the reforming part situated at the upstream side. Therefore, there has been adopted a constitution in which the shifting part and the purification part are heated sequentially with heat from the reforming part, for example, heat kept in reformed gas or surplus heat in the heating part.

[0006] In such constitution, however, a long time is required before the catalyst temperatures of respective reaction parts (reforming part, shifting part and purification part) are stabilized. Surely, there is no specific problem in a hydrogen generating apparatus which is usually operated in continuous mode used in a plant and the like since the operation can be effected while estimating the starting-up time. However, such constitution is not preferable in a hydrogen generating apparatus

OK to enter 1/6/04